

CLIMATOLOGICAL DATA FOR OCTOBER, 1912.

DISTRICT NO. 10, GREAT BASIN.

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GENERAL SUMMARY.

October weather in the Great Basin was unseasonably cool and stormy, the general inclemency causing delays and losses of a more or less serious nature to nearly all interests, especially in the eastern part of Nevada, and in Utah. The low temperatures were maintained with some uniformity throughout nearly the entire district, only a few stations reporting plus departures from the monthly means. The precipitation excesses occurred principally in western Utah and portions of Nevada, in which regions the number of cloudy days was appreciably greater; but to the westward in central and western Nevada, and in areas of adjacent States in the Great Basin, the precipitation excesses were much less, and the number of clear days greater; conditions thus being much more favorable for farming operations and for all outdoor work.

Owing to the heavy rains, country roads remained in bad condition most of the month in Utah, and the beet and potato fields were so soft as to greatly delay the gathering of these crops. Unthrashed grain and uncut hay stood in the fields at the close of the month in many counties awaiting a period of dry weather suitable for harvesting. However, a very good effect of the cool wet weather was noted in conditions on the dry farms; since these lands are mostly well-drained uplands, the excess of moisture served only to keep the soil in fine condition for plowing, and as farmers were prevented by the weather from working in other fields, the fall dry-farm plowing was probably farther advanced and in better condition at the close of October than for several years. During the second decade, which was the only period of fair weather during the month, a good acreage of dry-land wheat was sown, and this, together with the greater quantity that was sown during the last half of September, was in splendid condition, and the consensus of opinion is that the dry farming prospects have been rendered more propitious by proper weather sequences this autumn than they have been for several years.

Thunderstorms were nowhere numerous or severe, though during the last few days of the month single storms in many places broke previous records for continuous downfalls of rain. A great deal of snow occurred, and while most of this melted as it fell, sufficient remained on the hay and grass and on the fruit trees long enough to cause damage in some places by its weight. The valley floors were bare of snow at the close of the month, though all the mountains in the eastern portion of the Great Basin carried a good layer, and their peaks were white. There were no losses of consequence reported, due to frost, though some fields of alfalfa for seed were slightly damaged in central Utah. The number of clear days for the district was 15, partly cloudy days 6, and cloudy days 10.

TEMPERATURE.

The mean temperature for the district was 45° , which is 3° below the normal and more than a degree cooler than October of last year. Utah stations averaged 45.4° , or 3.2° below the normal, and Nevada stations averaged 45.8 , or 3.5° below normal. Only two stations reported values above normal; they were in Nevada. The warmest weather was confined to the flatter portions of the district, among the warmest places being Midlake, on the Southern Pacific Railway Co.'s trestle, in the middle of Great Salt Lake. Stations in west-central Utah, and in southern and southwestern Nevada reported the highest averages, and stations in the mountains of Utah and Wyoming the lowest averages. The month began warm over all the district but remained so for only a few days, most of the first and second decades being unusually cool and disagreeable. The beginning of the third decade was again comparatively warm, but most of the last 10 days was also abnormally cool.

PRECIPITATION.

The average precipitation for the district was 2.30 inches, which is 1.49 inches above the normal, or nearly three times the average for October, 1911. Utah stations averaged 2.99 inches, or 2.05 inches above the average, and Nevada stations averaged 1.34 inches, or 0.79 inch above. The greatest excesses occurred in Utah, many stations reporting amounts in excess of 4 inches, which is nearly one-third the normal annual amount in this region. Amounts in western Nevada were so small in some cases as to be below instead of above the normal, though no station reported a totally dry month. The first and third decades were stormy nearly everywhere, the heaviest storms, accompanied by the severest weather, occurring in the last decade. Snowfall during the last decade was reported at a large majority of stations, the amounts ranging above 2 feet at some mountain stations, though the average amount for the district was only 4.5 inches.

USING WEATHER DATA IN ENGINEERING PROBLEMS.

By ALFRED H. THIESSEN, Section Director.

The seer viewing the desert waste yielding subsistence to only a few worthless plants, or standing at night on an eminence contemplating the faintly lighted town having all the possibilities for industrial growth, except cheap light and power, and knowing of a bountiful water supply, which, indeed, he may even hear as it roars down its mountain bed on its way to the sea, conceives the possibility of holding this water in some natural or made pocket in the mountain canyon, and then allowing it, after it has provided power and light to the town, to

journey along carefully made canals and ditches watering the desert that it may yield a harvest. He sees in his mental picture a city in place of a village, now well-lighted and buzzing with activity; and the desert, once dry, hard, and gray, now made soft by the plow, moist by the irrigating ditch, and green with useful grasses and plants. He has thus laid the foundation of a general scheme which may or may not be feasible.

He then places his problem before the engineer, who, in addition to his technical knowledge, should have not only general ideas regarding the practicability of the scheme, but must acquire additional information concerning the fertility of the land, the topography, geology, and exact climatic conditions of the watershed.

The engineer should be interested in, not only the problems pertaining to matters of construction, but the ultimate success of the project as a whole, which may depend upon how few guesses he is required to make in his calculations. The engineering of an irrigation project, for instance, means, in the broadest sense, the study of the agricultural possibilities as well as dams, canals, and ditches. In all hydrological engineering problems the weather assumes the greatest importance, and it behooves the engineer in the study of such problems to give consideration to all climatic data that pertain to the area of country which concerns his project.

The Weather Bureau maintains in this country about 200 regular stations where all the weather elements are measured and recorded, about 4,000 other stations where temperature and rainfall are observed, and nearly 400 stations where river stages are recorded. These records in some parts of the East extend back as far as the beginning of the nineteenth century; but in the newer parts of the country records are shorter and cover only more recent years. Many of them are exceedingly valuable, and all may be used, no matter how short, for purposes of comparison.

Since the accumulation of exact instrumental data no permanent progressive changes in climate have been noted, although small periodic changes have been observed through relatively short spaces of time. The most noted of these is the 35-year period of Brückner, who teaches that a period of cool, wet years will be followed by one of warm, dry years. The complete oscillation from cool, wet years to dry, warm years and back again will not in most cases occupy 35 years, but will vary all the way from 20 to 50 years. Therefore the engineer, in studying temperature and precipitation data, must take into account the fact that the record, if short, may have been taken at a time of maximum rainfall and cool weather, or the reverse. To make use of short records, he must have recourse to the long records of surrounding stations, compare the short record with that portion of the long record covering the same dates, find the mean variation, and interpolate accordingly.

An understanding of the system of compiling weather data should be gained to interpret them. The Weather Bureau publishes each month tables of precipitation showing the daily local amounts with the total for the month; while in annual reports the monthly amounts are given with the yearly totals. While such compilations give all the data needed for most problems, it may be best for the solving of special cases to work over the data in other forms. In the case of building a storage dam, it may be better to consider the precipitation year as beginning with the commencement of the storage period. The monthly amounts of precipitation may not be, in some cases, in sufficient detail to supply data for the

engineer that he might provide suitable structures to accommodate unusual amounts of water occasioned by especially heavy storms. A detailed study is of the greatest importance when dealing with a small watershed. When large amounts are found in the tables either on the first or last days of the month, the engineer should consult the record of the preceding or succeeding dates to ascertain the duration of the storm and the whole amount precipitated.

In the monthly reports the average monthly temperatures with the highest and lowest are published for each station, together with the highest and lowest readings at typical places. The annual reports show the average monthly and annual temperatures with the highest and lowest for the year. A consideration of temperature data is very necessary in all hydrological engineering problems, but especially in those connected with irrigation.

The first consideration regarding these matters in a semiarid country is whether there is enough rainfall over the watershed to make the project financially practicable; and second, precipitation must be studied in reference to the structural details as to size, strength, and shape of the retaining structure and its accessories.

If the actual run-off of the stream were known, then precipitation data for the watershed would be of less value, but it is seldom that run-off measurements have been made for a sufficient length of time to determine the true normal. Run-off varies with the amount of precipitation, and the latter varies so from year to year that it is necessary to have at least a 10-years' record in order to compute a normal that can be considered fairly accurate.

A most important consideration, then, in planning for a water-power or irrigation project is that pertaining to the sufficiency of water, and data relative to precipitation are therefore fundamental and of the greatest importance, for there must be enough water assured even in the driest season.

The following are some of the conditions that the engineers meet in work of the above character: (1) Some districts have good run-off and precipitation records; (2) some have good run-off records but no precipitation records, or the reverse; and (3) some have neither run-off nor precipitation records.

In the case where there are both good run-off and precipitation records it may be that the latter cover a longer period than the former, and by comparing one with the other, year by year, it is possible to lengthen the run-off record by establishing the relation of the one to the other.

Where a good precipitation record is available, but no run-off, it may be practicable to select another watershed having the same topographic and geologic features where records have been taken, and the relation between the run-off and precipitation in the trial watershed may be applied to the one under consideration.

If the run-off record is short and the rainfall has not been measured, then the wisest procedure is to compare the run-off with the rainfall records of the nearest surrounding watersheds. This comparative study will indicate whether the run-off for the short period is higher or lower than the normal.

It may be that the run-off record was made during either a dry or a wet period. It is important for the engineer to know this, for an irrigating project to be successful must have a certain amount of water every season. In the case just cited it is desirable that the period of precipitation record should include the run-off records. A careful comparison of the run-off should first be made

with the precipitation of the corresponding period, both year by year and period by period. Then the entire precipitation record should be studied year by year with the end in view of ascertaining what records of run-off represent the minimum.

The greatest difficulty is when neither run-off nor rainfall observations are available. Then the engineer must have recourse to other watersheds where records have been kept, and must make his deductions accordingly. He should be exceedingly cautious in this, however, as the problem is a very complex one, and it is impossible to assign to every influence its true weight, so that an approximate conclusion is all that can be hoped for. The trial watershed should have physical characteristics similar to the one in which the engineer is concerned, but as it is quite impossible to select one which exactly corresponds he must make certain allowances which can only be estimated.

The engineer should have the broadest interest in his project. If it is an irrigating scheme, then he should not only be interested in the purely structural details, but be convinced by his own investigations as to the sufficiency of water at his disposal and the kinds of crops which can be grown on the area to be irrigated. To study these questions all weather information pertaining to his country is of value, but temperature and precipitation data are of the greatest importance.

In studying temperature the records of all stations in the watershed should be carefully considered. The tables should be recompiled, if necessary, that the following may be learned: The average temperature and length of the growing season, the highest and lowest temperature during each month of the growing season, the

average date of last killing frost in spring and of the first in autumn, the extreme minimum temperatures during winter. These data will enable the engineer to define just what crops can be grown.

Usually in countries where irrigation is practiced there is an abundance of sunshine, so that this very important element, affecting plant life about as powerfully as temperature, need be considered only in a general way.

Humidity and wind velocity have considerable effect on the drying out of the top soil and upon the processes of plant growth and should be considered in relation to these.

Knowing, then, the weather conditions obtaining over his area, the engineer may pick out an older region agriculturally, having like climatic characteristics, and from a study of its products form very accurate ideas as to the agricultural possibilities of this new land. A study of the natural flora of the region is also helpful.

In the study of precipitation it is always best, especially when dealing with short records, to consider the records of several stations at once. Precipitation is irregular, and in order to estimate the moisture falling over a region it is quite advisable to get the average of several points, as the record of a single station will rarely tell the whole story. This is particularly so in the case of single showers.

The engineer, after having secured all the data possible, may now reduce his general problem to the least number of guesses. He can now verify the mental picture of the seer's dream. He knows whether he can or can not bring about a city with light and power and a countryside of profitable farms.